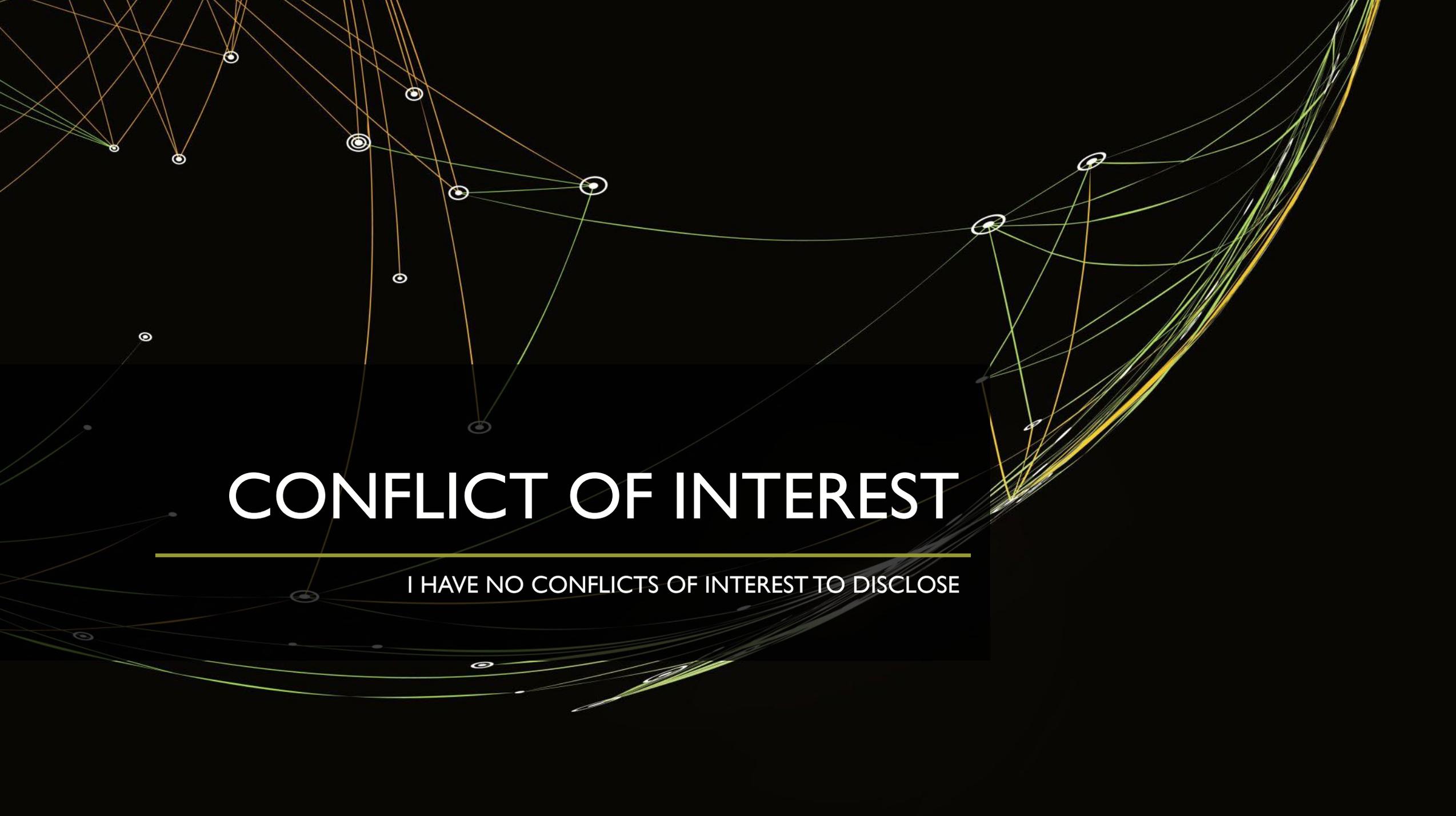


KIP WENGER, DO  
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MEDICINE

# TEACHING CLINICAL REASONING TO OMS 3'S AND 4'S



# CONFLICT OF INTEREST

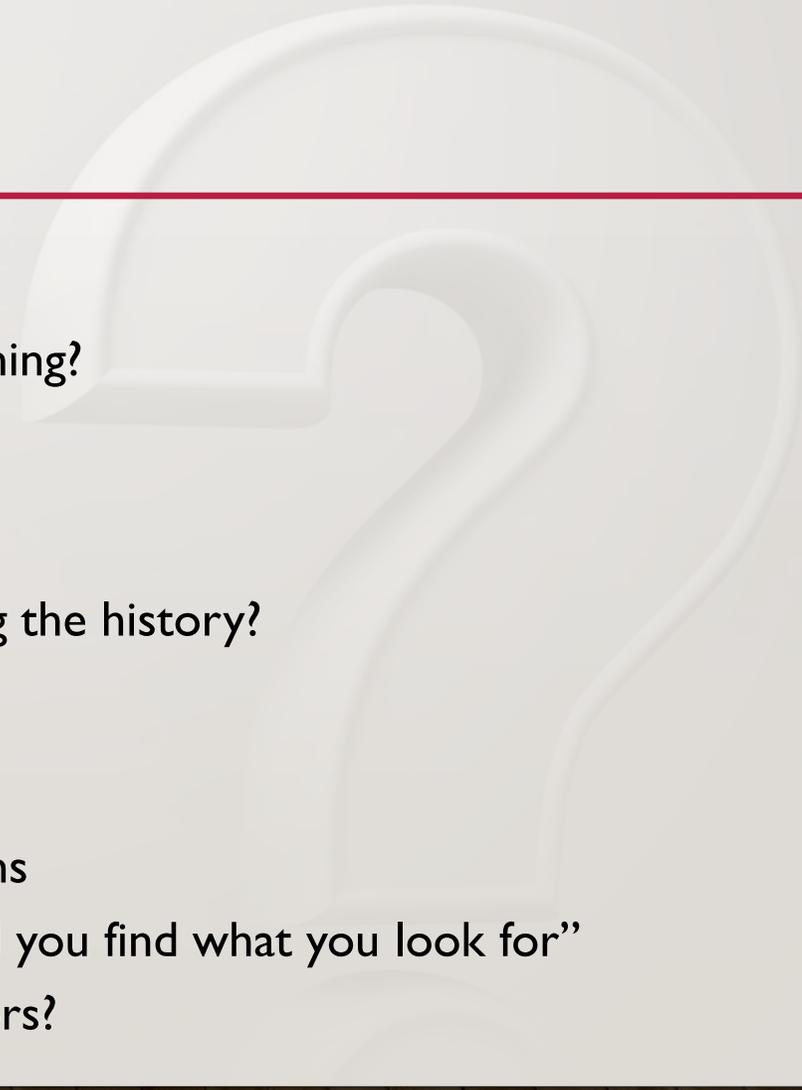
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I HAVE NO CONFLICTS OF INTEREST TO DISCLOSE

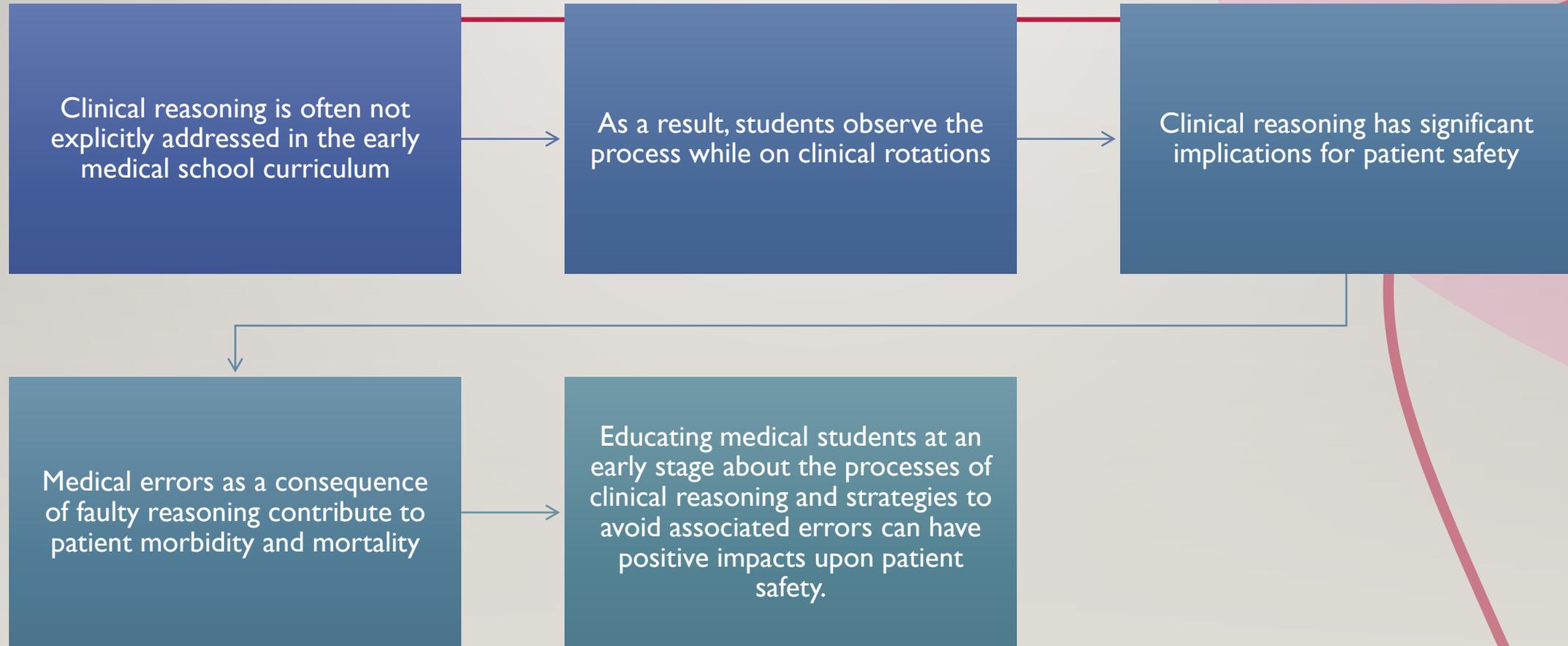
# DISCUSSION GOALS

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- How do OMS 3's and 4's approach clinical reasoning?
- How do experienced clinicians' approach clinical reasoning?
- How can we bridge / teach to minimize the gap?
- What is metacognition?
- What is the role of the differential diagnosis in directing the history?
- Diagnostic testing and the role of prevalence
- Causes for Errors in clinical reasoning
  - ✓ Poor history acquisition. ..Asking the right questions
  - ✓ Poor knowledge “you look for what you know, and you find what you look for”
  - ✓ What are the reasons for common diagnostic errors?



# MEDICAL EDUCATION AND CLINICAL REASONING



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Our ability as clinicians to accurately diagnose patients is foundational in our role as physicians. The strategies clinicians use to arrive at a diagnosis, particularly in primary care, make only a small contribution to current research and undergraduate medical education.

# DANGER! PRECEPTING MEDICAL STUDENTS MAY ALTER YOUR PRACTICE OF MEDICINE

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Good judgement comes from experience

And experience comes from.....

**Bad Judgement!**

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Certainly, there must be a better way???

Is there a shortcut?

# #1 PRECEPTOR COMPLAINT ABOUT STUDENTS

Students can't take a decent history !

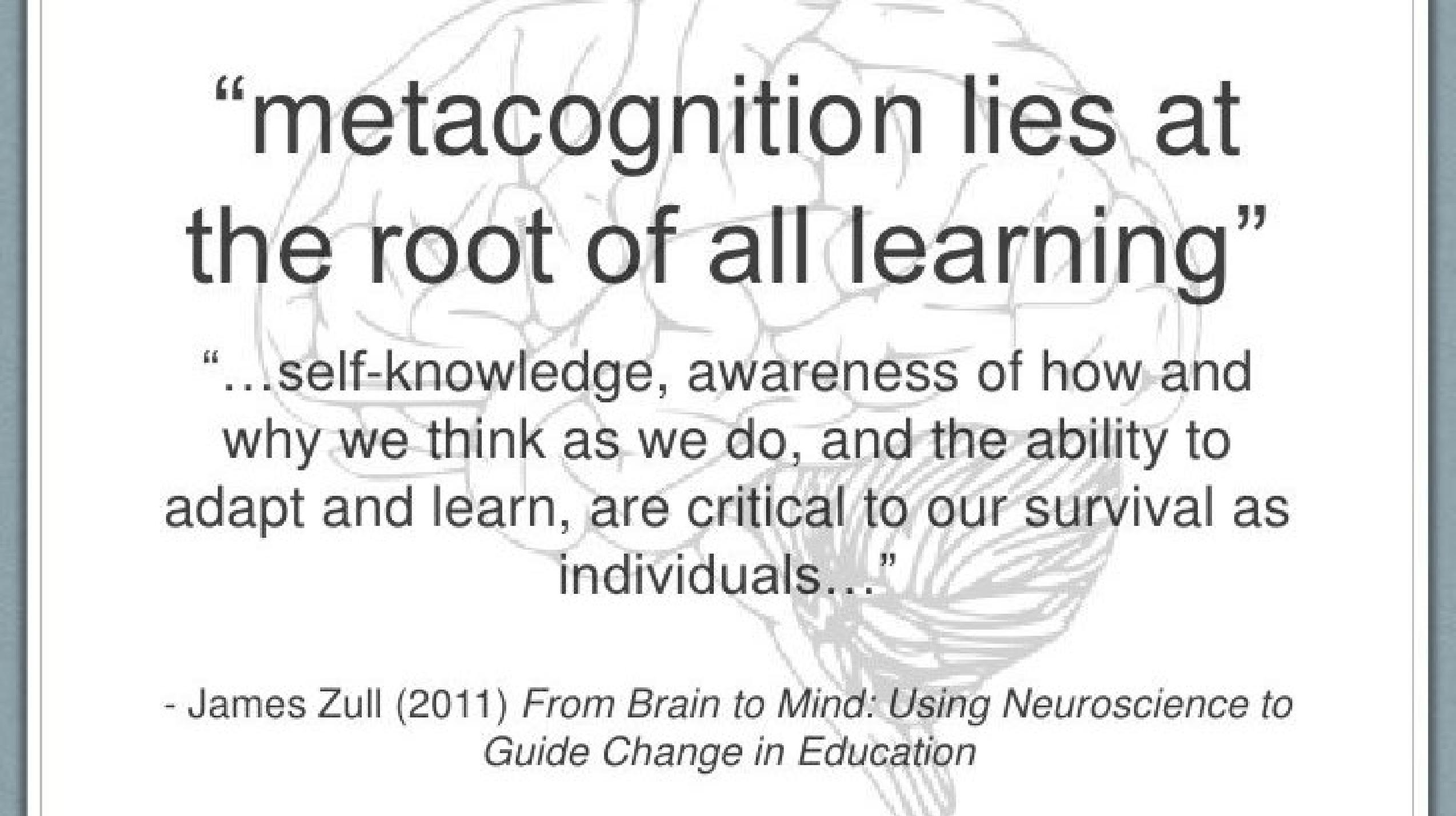
- They don't know what questions to ask
- They don't know how to ask questions
- They default to asking everything out of the fear of missing something
- They don't know what historical information is important

# YOU LOOK FOR WHAT YOU KNOW AND YOU FIND WHAT YOU LOOK FOR SO .....

---

- Do we need to fill our brains with as many factoids as possible?
- The application of factoids to a clinical scenario without an appreciation for the pretest probability of disease is prone to error
- Uncommon presentations of common disease are more common than common presentations of uncommon diseases
- So how do we make a clinical diagnosis?





“metacognition lies at  
the root of all learning”

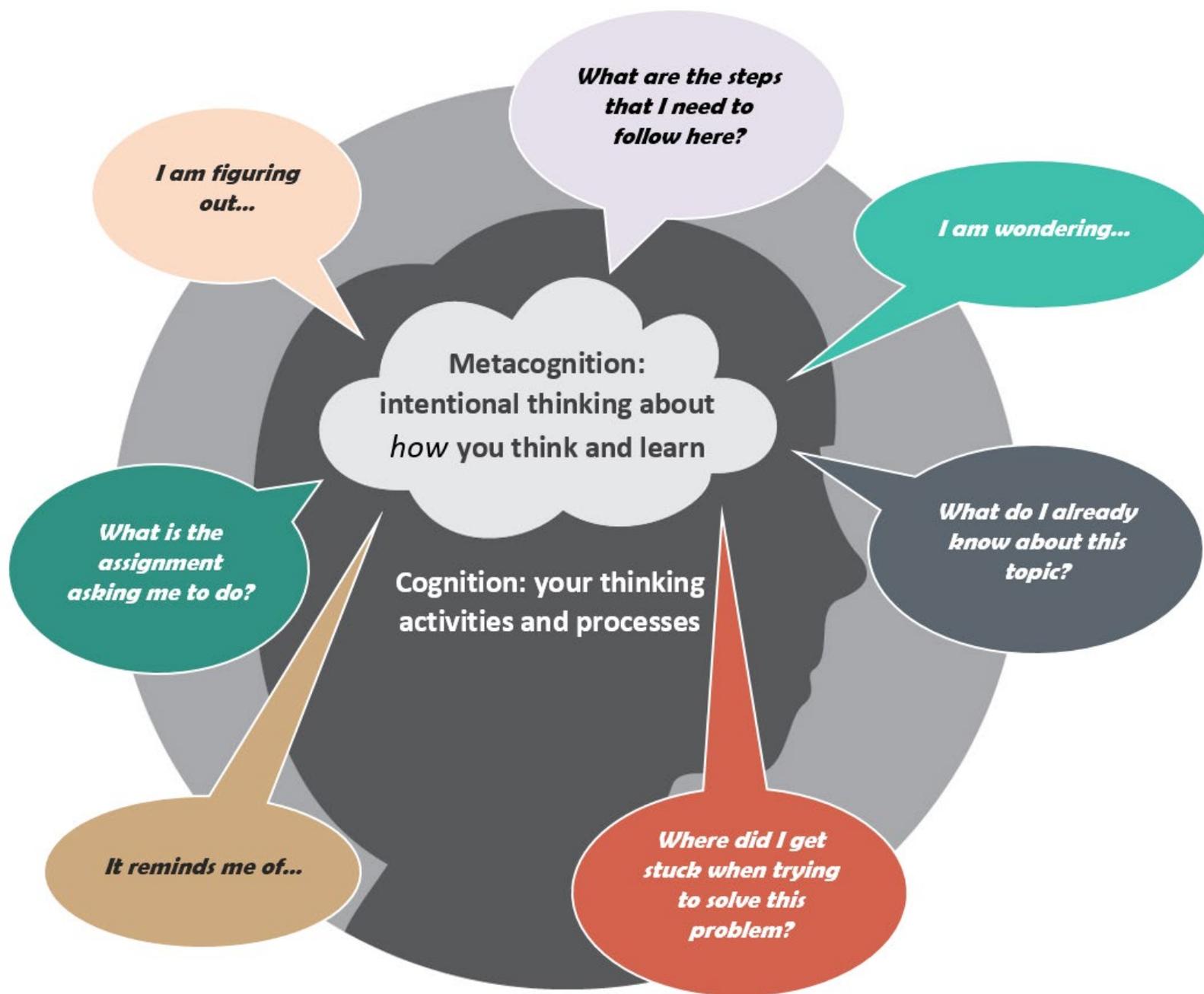
“...self-knowledge, awareness of how and  
why we think as we do, and the ability to  
adapt and learn, are critical to our survival as  
individuals...”

- James Zull (2011) *From Brain to Mind: Using Neuroscience to  
Guide Change in Education*

# WHY AN UNDERSTANDING OF METACOGNITION IS IMPORTANT FOR THE CLINICIAN AND THE STUDENT

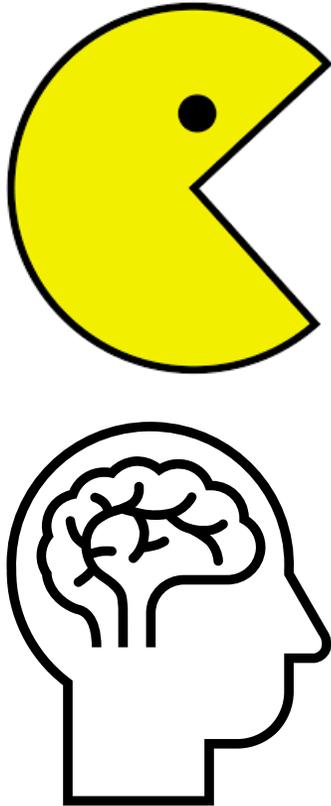
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- Clinical educators who are experienced clinicians may find it difficult to explain and teach clinical reasoning because it has become ingrained in our way of thinking
- An understanding of metacognition bridges or at least helps us understand the gap between expert and novice clinical reasoning



# MEDICAL STUDENTS ACQUIRE FACTS WITHOUT CLINICAL CONTEXT

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- The historical information seems random
- The priority is on the quantity of historical information
- All historical information is weighted similarly
- The history is not focused on the differential diagnosis that is generated during the evaluation

# H&P ACQUISITION METACOGNITION

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- Front tire / back tire analogy
- Students are all back tire with very little use of the front tire
- The expert clinician steers the history and physical exam to address the initial differential diagnosis that is formulated based on the chief complaint and history of chief complaint

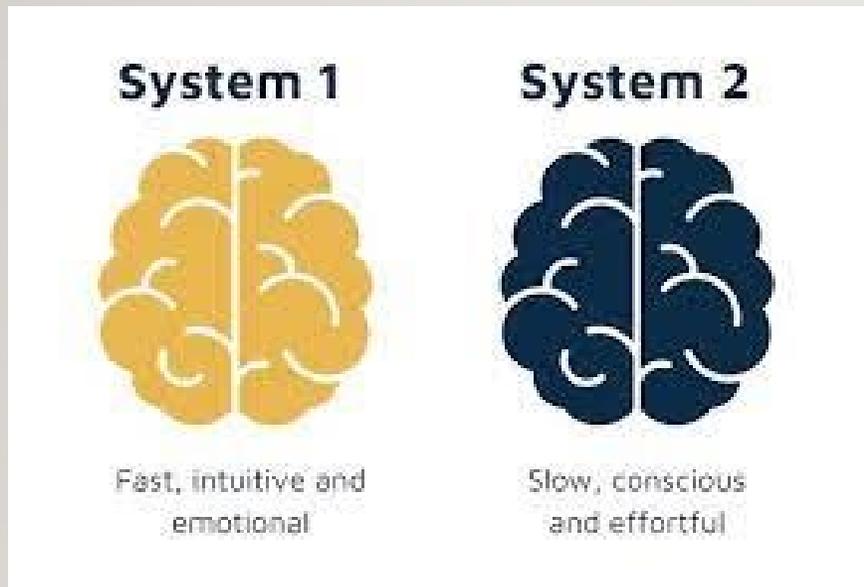


# OMS 3'S & 4'S VERSUS EXPERIENCED CLINICIAN

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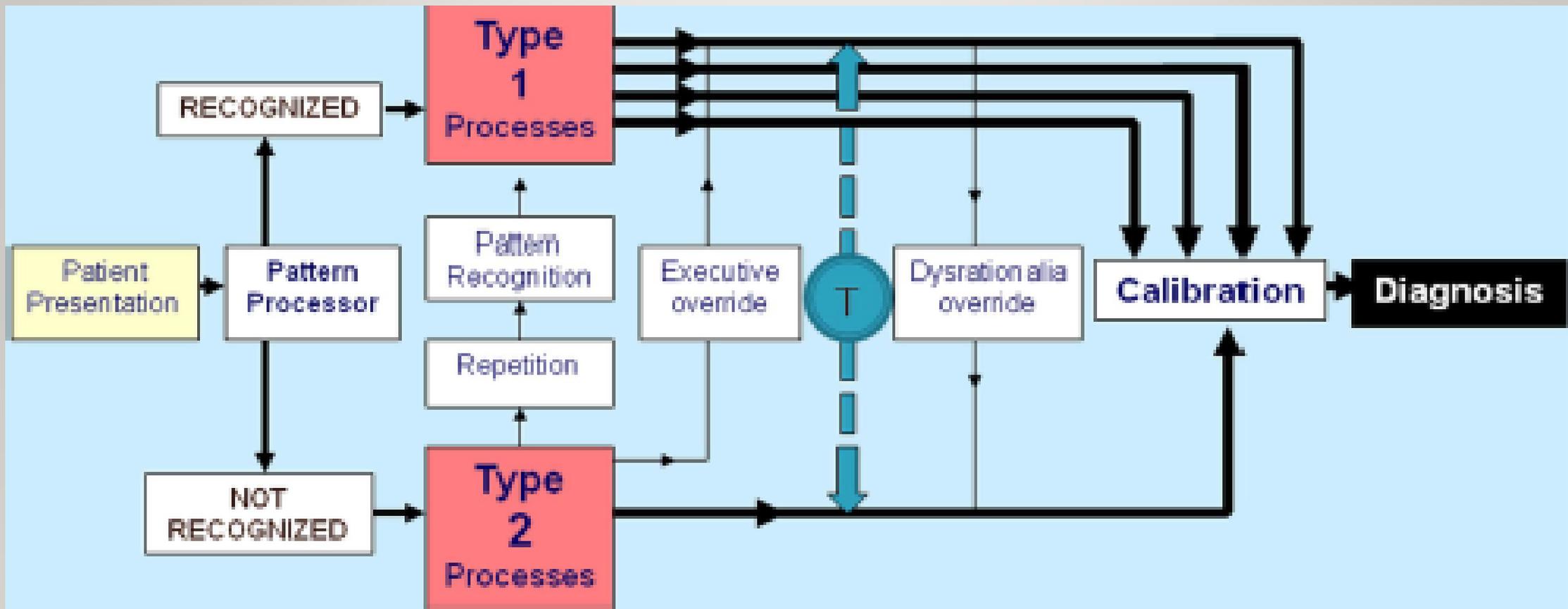


# SYSTEM 1 AND SYSTEM 2 THINKING



## Table 1. Some features of analytical and non-analytical processes

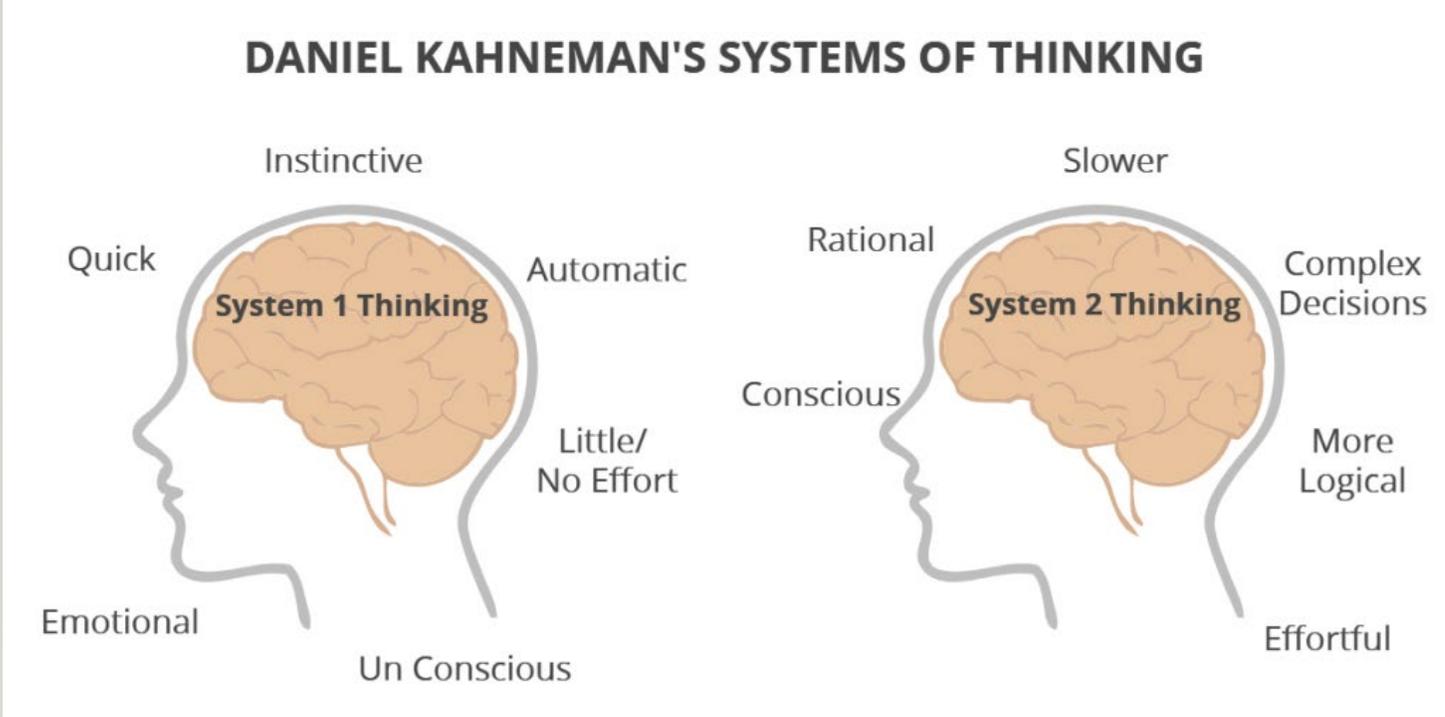
Non-analytical system 1	Analytical system 2
fast	slow
subconscious	conscious
low effort	high effort
involuntary	voluntary



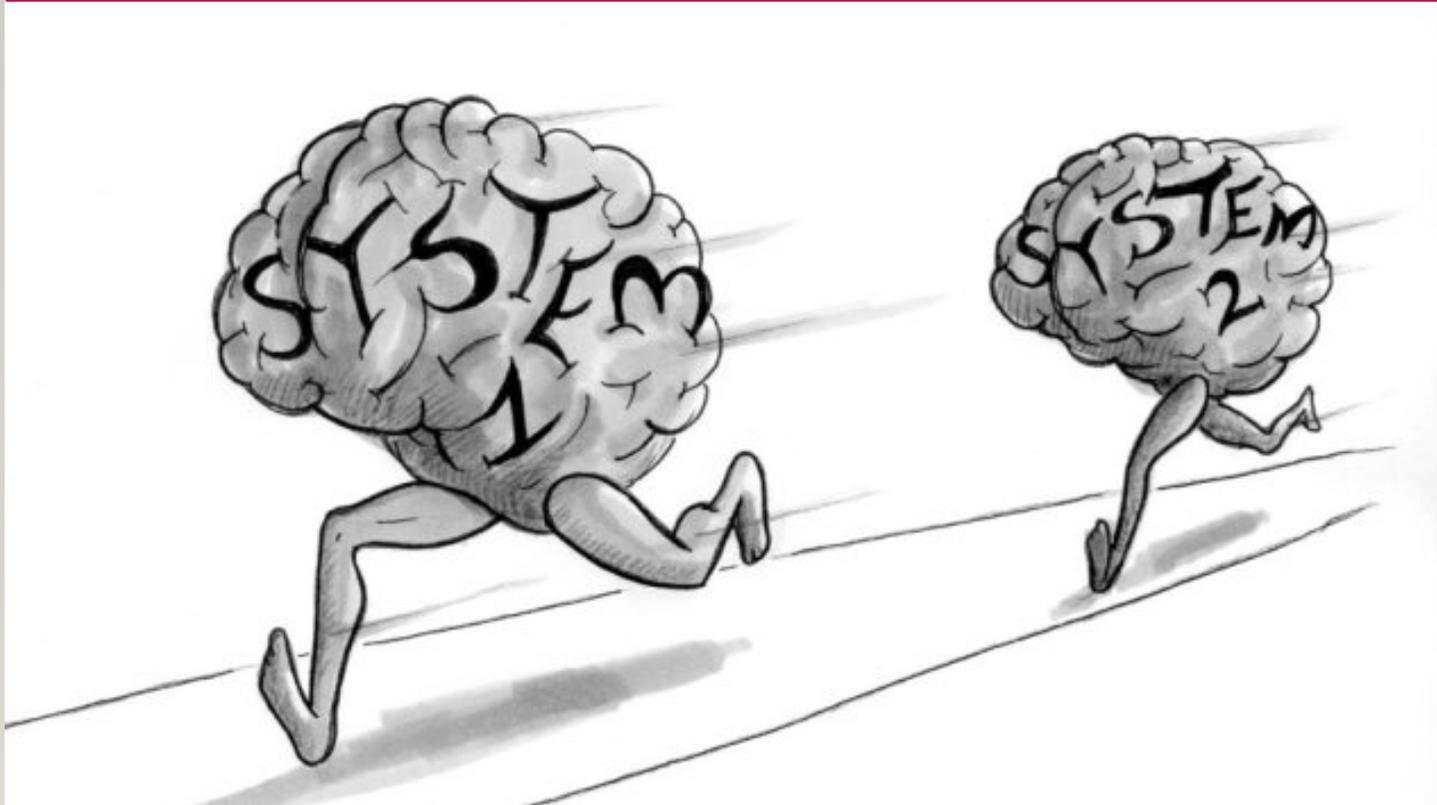
# DUAL PROCESS MODEL FOR DECISION MAKING

CROSKERRY P, ET AL. BMJ QUAL SAF 2013;22:II58-II64

# SYSTEM 1 AND 2 THINKING



# SYSTEM 1 AND SYSTEM 2 THINKING



# SUMMARY OF CLINICAL REASONING APPROACH OF OMS 3'S & 4'S

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- OMS-3's are generally unfocused collectors of historical information
- The goal is to transition them to being focused collectors of relevant information
- The core elements are the ability to gather, understand, and integrate clinical evidence and then interpret the evidence using medical knowledge, and summarize relevant diagnoses. ...
- It has been assumed that these skills will be learned by accumulating a body of knowledge and by observing expert clinicians

# MODELS OF MEDICAL DECISION MAKING

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- Pattern recognition / Heuristics / “Aunt Minnie”
  - ❖ “That looks like measles”
- Algebraic method
  - ❖ Bayesian probability estimations (we don’t think Bayesian very well)
- Hypothetico deductive method
  - ❖ This is what we often use...best studied
  - ❖ Hypotheses (diagnostic considerations) are tested
- Rule out worse case scenario method

# PATTERN RECOGNITION / HEURISTICS

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- Pattern recognition is efficient
- Pattern recognition is crowd pleasing and ego satisfying
- Atlas of dermatology is the most used book in the ED



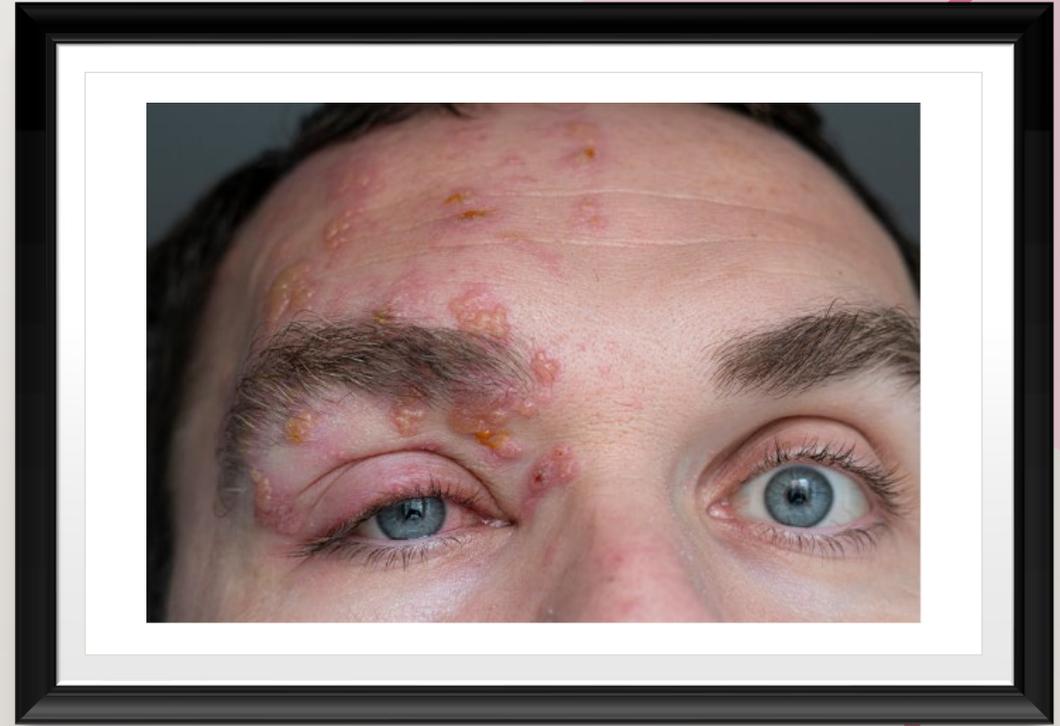
Emergency medicine is  
pattern recognition and  
knowledge translation, as  
well as the guts to take  
action, based on limited  
information

– *Unknown*

# PATTERN RECOGNITION / HEURISTICS

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- Painful, unilateral, rash involving a single dermatome of the forehead
- **Shingles!!**



## 75 YO MAN WITH “PSORIASIS”

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- A 75 yo male presents with a history of being treated by his physician for the last 6 months for a new onset of psoriasis with little improvement. He is seeing you for a “second opinion”- the rash has spread from his abdomen to shoulders over the past 2 months. It is mildly pruritic and not painful
- PMHx: denied, no history of prior dermatologic disease, he denies current medication

# CASE #4

## THE OLD MAN WITH “PSORIASIS”



# PATTERN RECOGNITION

## THE OLD MAN WITH “PSORIASIS”

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- Derm: multiple erythematous scaled plaques in a truncal distribution
- Further exam reveals diffuse lymphadenopathy

# PATTERN RECOGNITION / HEURISTICS

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- Our brains search for familiar patterns
- We take comfort in finding familiar patterns and we are quick to stop searching for answers when a familiar pattern is identified\*
- Premature anchoring allows us to move to the next problem and relax our efforts to think
- Our brains are quick to identify and assign causality where there is none



# ALGEBRAIC METHOD

## BAYESIAN PROBABILITY ESTIMATIONS

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- Human brains don't process probabilities very well
- Thinking probabilistically is unnatural
- We play lotteries but we are afraid to board a plane
- There is a biological and evolutionary advantage to over-estimating small probabilities that are potentially lethal
- Being able to think in a statistically sound way is an essential attribute of a clinician

# CLINICAL SUSPICION AND PREVALENCE

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Clinical suspicion is derived from the history, the physical, age, social issues, and disease prevalence

Pretest probability: How probable do I think this disease is even before I perform any tests?

“If I had a thousand patients who looked *just like this one*, what would the prevalence of disease be?”

# PREVALENCE OF LETHAL DISEASE “THE USUAL SUSPECTS”

---

Estimate of 900,000 PE's year (1/3 die)

805,000 MI's each year

695,000 deaths from heart disease (1/4 of all deaths)

100,000-125,000 with prolonged QT syndrome deaths?

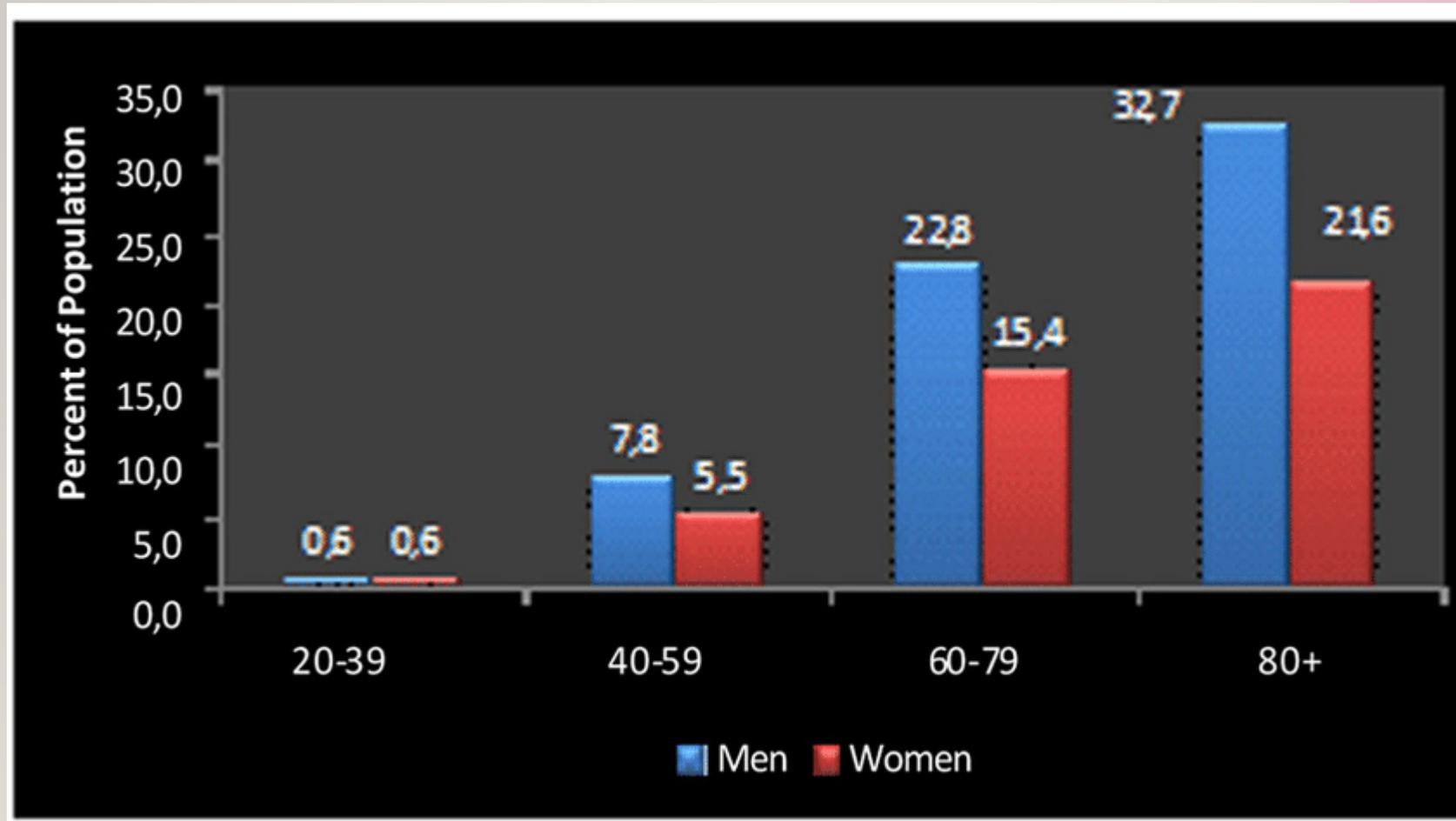
SAH 30,000 cases per year, 40% mortality

SMA thrombosis 25,000, 50% mortality

AAA 15,000 deaths > 50% mortality

Bacterial Meningitis < 10,000 cases per year (<1000 deaths)

# PREVALENCE OF CORONARY ARTERY DISEASE BY AGE AND SEX IN UNITED STATES IN 1999 -2004





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# CONJUNCTION FALLACY

# THE LINDA PROBLEM

- Linda is a young art school graduate, lives in a big city and self identifies as a left-winger
- Which is more probable about Linda?
  - 1) She works as a fire fighter
  - 2) She works as a firefighter and campaigns for women's rights



# CONJUNCTION FALLACY:

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An inference from an array of particulars, in violation of the laws of probability, that a conjoint set of two or more conclusions is likelier than any single member of that same set

# BAYESIAN PROBABILITY ESTIMATION EXAMPLE

The probability of breast cancer is 1% for a woman at age forty who participates in routine screening

If a woman has breast cancer, the probability is 80% that she will get a positive mammography

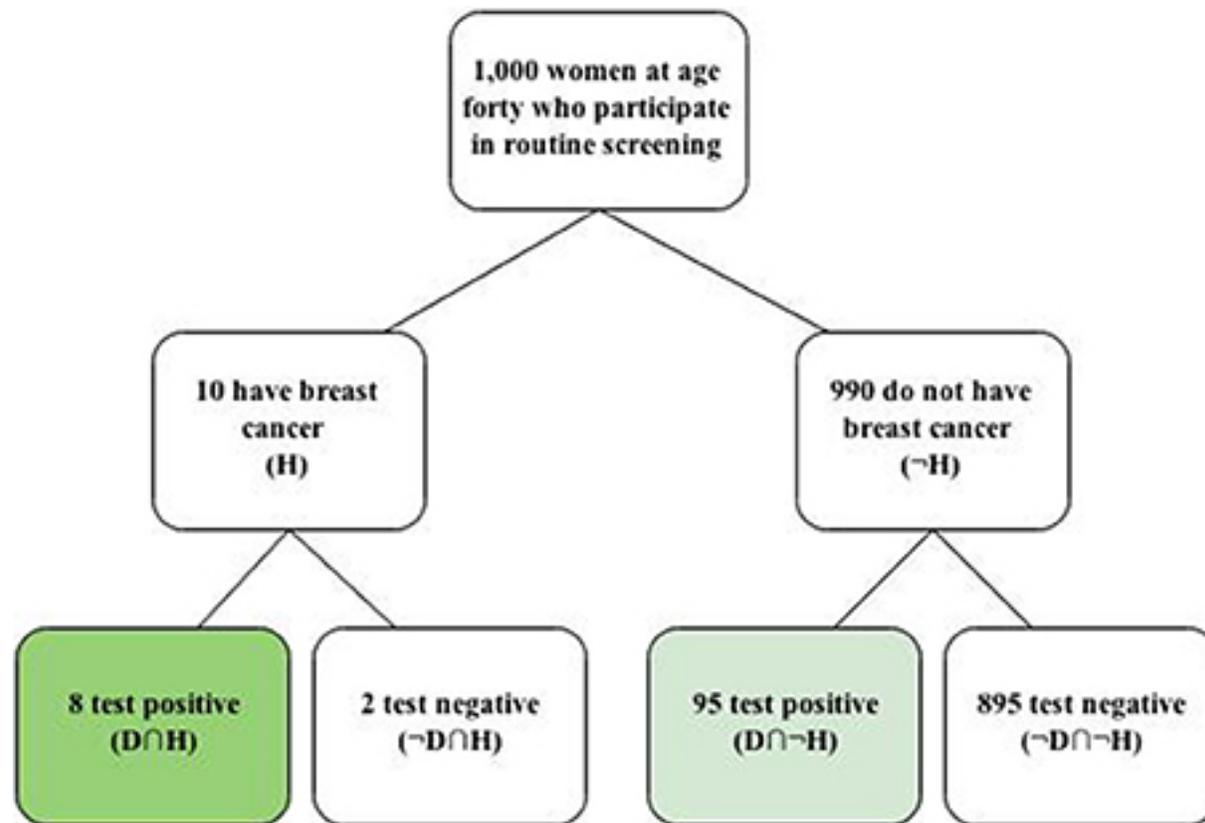
If a woman does not have breast cancer, the probability is 9.6% that she will also get a positive mammography

A woman in this age group had a positive mammography in a routine screening

What is the probability that she actually has breast cancer? \_\_ %.

GIVEN THE INFORMATION PROVIDED IN THE PRIOR SLIDE WHAT IS THE LIKELIHOOD THAT THE 40-YEAR-OLD WOMEN WITH A POSITIVE MAMMOGRAM HAS BREAST CANCER?

- A 80%
- B 90%
- C 8%
- D 50%



$$P(H|D) = f(D \cap H) / f(D) = \frac{\text{8 test positive (D} \cap \text{H)}}{\text{8 test positive (D} \cap \text{H)} + \text{95 test positive (D} \cap \text{¬H)}}$$

# BAYESIAN PROBABILITY ESTIMATION

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- Bayes' theorem states:  $P(H|D) = \frac{P(H)P(D|H)}{P(H)P(D|H) + P(\neg H)P(D|\neg H)}$ .
- It yields a posterior probability of 0.078 in the mammography problem
- The majority of physicians who were queried gave estimates roughly one order of magnitude higher
- Well-established findings such as these have supported the view that expert and naïve subjects alike are non-Bayesian ([Kahneman and Tversky, 1972](#))
- A common explanation is that people neglect base-rate information, which is not tracked by the intuitive heuristics they use to reach an estimate ([Kahneman and Tversky, 1972, 1973](#)).

# HOW DO WE MAKE A DIAGNOSIS

## HYPOTHETICO-DEDUCTIVE REASONING

---

- Seminal research in the 1970s showed that the commonly taught sequential approach to history taking and examination, resulting in differential diagnosis and ultimately a final diagnosis, is not what practitioners do in reality
- Researchers observed that diagnostic hypotheses are made early in the consultation and guide subsequent history and examination, in a process of hypothetico-deductive reasoning

# DIFFERENTIAL DIAGNOSIS

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- The creation of the differential diagnosis often starts before you take a history...nurses notes, watching the patient walk into the room, etc
- Based on likelihood or seriousness
- Students are generally not good at estimating pretest probability

# AS CLINICIANS WE TAKE SHORT CUTS AND BEGIN BUILDING OUR DIFFERENTIAL DIAGNOSIS FROM THE CHIEF COMPLAINT

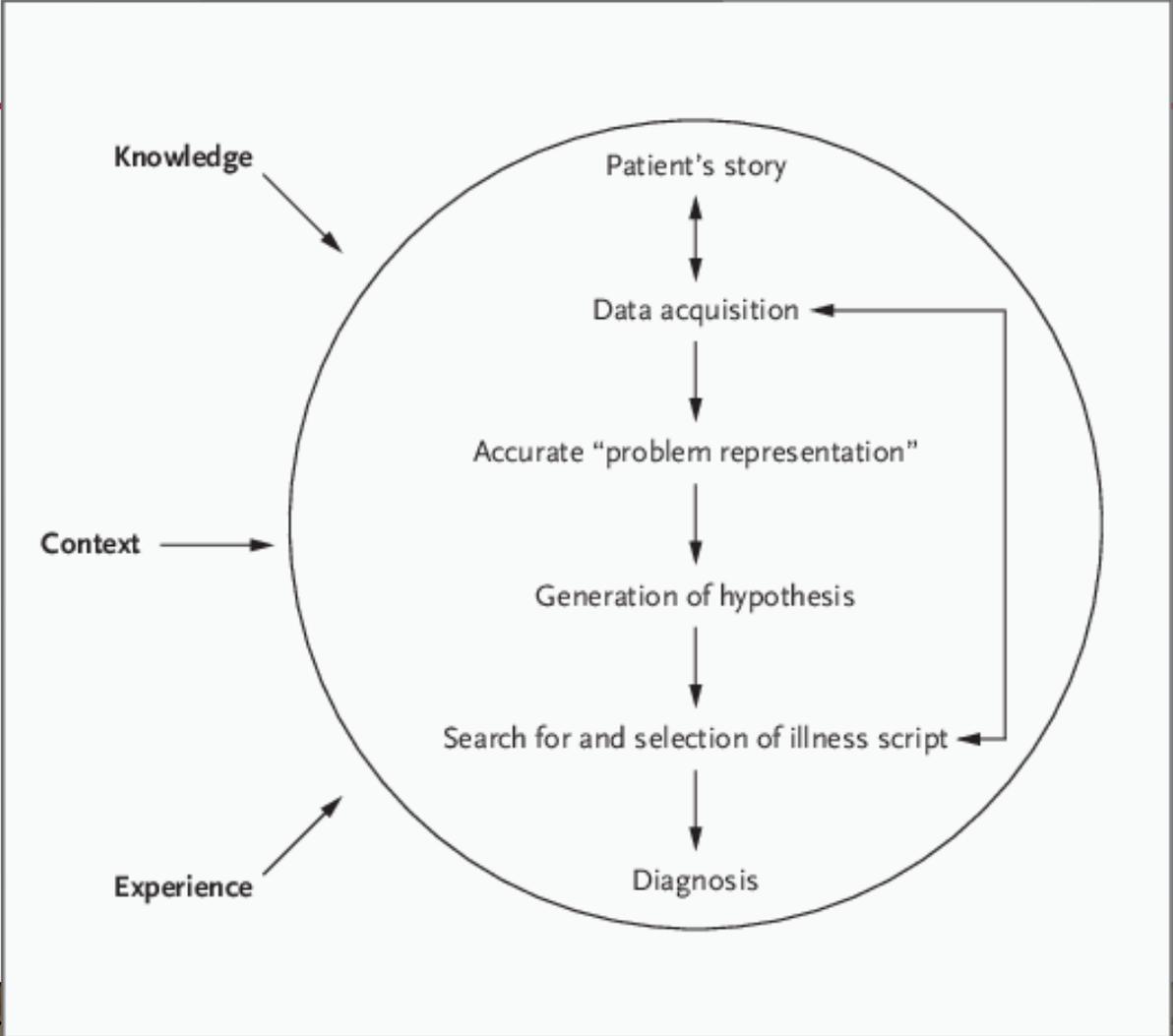
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- The history we obtain is driven by our early diagnostic impressions or *considerations*
- This is generally not true with medical students

# THE CHIEF COMPLAINT DIRECTS THE HISTORY EXAMPLE.....ABDOMINAL PAIN

- Onset
- Character
- Severity
- Location
- Migration
- Nausea
- Vomiting
- Diarrhea
- Anorexia
- Fever
- Prior episodes
- Surgical history
- FDLMP
- Pregnancy potential
- Urinary complaints

# CLINICAL REASONING



# MURTAGH'S DIAGNOSTIC STRATEGY

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- The 'restricted rule-out', or Murtagh's process, is a diagnostic strategy based on the most common cause of the presenting problem and a list of serious diagnoses that must be ruled out. The 'diagnostic pause' or 'time out', has been described as a useful tool to minimize diagnostic error
- This fail-safe diagnostic model encourages doctors to focus on the probability diagnosis and the differential diagnoses for the particular presenting problem, and also to consider life-threatening causative conditions that must not be missed

# PREVALENCE AND THE USE OF DIAGNOSTIC TESTS

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- The value / utility of a diagnostic test is dramatically altered by the prevalence / pretest probability of disease
- Sensitivity and specificity are test characteristics
- The predictive value of a test can only be determined by knowing the prevalence of disease
- Common diseases should be diagnosed frequently, and uncommon diagnoses should be diagnosed infrequently.
- Uncommon presentations of common diseases are more common than common presentations of uncommon diseases

# ADVICE TO MEDICAL STUDENT PRECEPTORS

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- Emphasize clinical reasoning skills: Teach students various clinical reasoning strategies that help them analyze and interpret patient information effectively. These strategies may include:
  - a. Pattern recognition: Encourage students to recognize common clinical patterns and associations to expedite the diagnostic process
  - b. Hypothetico-deductive reasoning: Teach students to generate hypotheses based on the available information and systematically test these hypotheses to reach a diagnosis
  - c. Bayesian reasoning: Help students understand the concept of pre-test and post-test probabilities, and how to update diagnostic probabilities based on new information
  - d. Dual-process thinking: Highlight the importance of both analytical Type 2 (slow, deliberate) and Type 1 intuitive (rapid, unconscious) thinking processes in diagnostic reasoning

# EXPERTS AND TEACHING

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## Expert teachers

- Know the difficulties students are likely to face when learning
- Are good at knowing what existing knowledge students have so they can make new information meaningful ....assessing what they know about the topic
- Are comfortable sharing diagnostic pitfalls
- Have pedagogical content knowledge not just content knowledge

# HOW TO MAKE YOUR THINKING VISIBLE

## Principle

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1. Articulate

## Action

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- Make explicit the thinking required
  - Reverse engineer your own thinking. Explain and describe how you think through problems and issues
2. Make concrete and visible
- Identify thinking behaviours – what expert thinkers ask and say when they engage in thinking
4. Refine, chunk & sequence
- Refine and group the thinking behaviours into useful heuristics – thinking routines
5. Enculturate
- Make the thinking a routine part of your teaching
  - Repeat and model thinking routines
  - Encourage students to frequently and regularly use these routines

# MEDICAL DECISION MAKING AND BIAS

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- Do you believe that you are biased?
- To what extent does bias influence your medical decision making?
- Is there anything we /you can do to overcome our bias?
- Common forms of bias:
  - Confirmation bias
  - Availability bias and premature anchoring
  - Attribution bias

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“the fool doth think he is wise, but the wise man knows himself to be a fool”

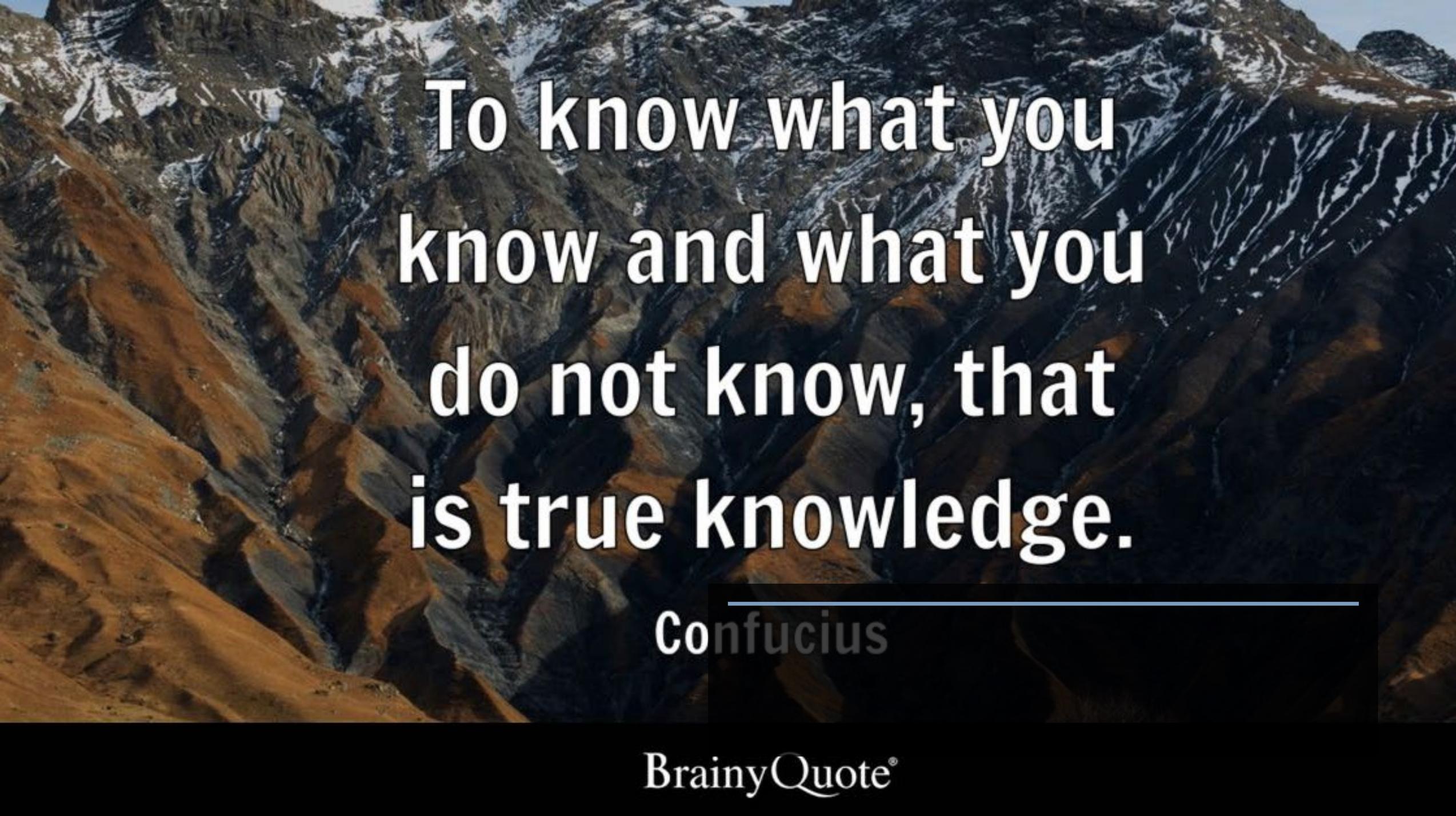


# PREMATURE ANCHORING

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- We identify an early diagnosis and anchor ourselves to it





To know what you  
know and what you  
do not know, that  
is true knowledge.

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Confucius

BrainyQuote®

# CONCLUSION

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- Clinical reasoning errors are responsible for a significant amount of morbidity and mortality
- Clinical reasoning is often not explicitly addressed in the early medical school curriculum
- Students most frequently rely on observation in their third and fourth years to develop and improve their clinical reasoning skills
- Educating medical students at an early stage about the processes of clinical reasoning and strategies to avoid associated errors can have positive impacts upon patient safety
- Thank you for helping the next generation of students become competent physicians

# REFERENCES

presentation title

20XX

- Croskerry P. Clinical cognition and diagnostic error: applications of a dual process model of reasoning. *Adv Health Sci Educ Theory Pract*. 2009;14 Suppl 1:27-35. PMID: [19669918](#)
- Croskerry P. Diagnostic Failure: A Cognitive and Affective Approach. In: Henriksen K, Battles JB, Marks ES, Lewin DI, editors. *Advances in Patient Safety: From Research to Implementation (Volume 2: Concepts and Methodology)*. Rockville (MD): Agency for Healthcare Research and Quality (US); 2005 Feb. PMID: [21249816](#) [[Free full text](#)]
- Croskerry P. ED cognition: any decision by anyone at any time. *CJEM*. 2014;16:(1)13-9. PMID: [24423996](#)
- Croskerry P. The importance of cognitive errors in diagnosis and strategies to minimize them. *Acad Med*. 2003;78:(8)775-80. PMID: [12915363](#)
- Croskerry P. From mindless to mindful practice—cognitive bias and clinical decision making. *N Engl J Med*. 2013;368:(26)2445-8. PMID: [23802513](#)
- Groopman, J. (2008). *How Doctors Think*, Houghton Mifflin Harcourt.
- Tversky A, Kahneman D. Judgment under Uncertainty: Heuristics and Biases. *Science*. 1974;185:(4157)1124-31. PMID: [17835457](#)

**Table 1** High-risk situations for biased reasoning

<b>High-risk situation</b>	<b>Potential biases</b>
1. Was this patient handed off to me from a previous shift?	Diagnosis momentum, framing
2. Was the diagnosis suggested to me by the patient, nurse or another physician?	Premature closure, framing bias
3. Did I just accept the first diagnosis that came to mind?	Anchoring, availability, search satisficing, premature closure
4. Did I consider other organ systems besides the obvious one?	Anchoring, search satisficing, premature closure
5. Is this a patient I don't like, or like too much, for some reason?	Affective bias
6. Have I been interrupted or distracted while evaluating this patient?	All biases
7. Am I feeling fatigued right now?	All biases
8. Did I sleep poorly last night?	All biases
9. Am I cognitively overloaded or overextended right now?	All biases
10. Am I stereotyping this patient?	Representative bias, affective bias, anchoring, fundamental attribution error, psych out error
11. Have I effectively ruled out must-not-miss diagnoses?	Overconfidence, anchoring, confirmation bias